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APPLICATION  
FOR  
UNITED STATES  
LETTERS PATENT

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For: DEBURRING METHOD AND  
AUTOMOTIVE KNUCKLE  
Docket No.: N45-160012M/YAH

## DEBURRING METHOD AND AUTOMOTIVE KNUCKLE

### BACKGROUND OF THE INVENTION

The present invention relates to a deburring method for  
5 removing a burr formed at an open end portion of a through hole,  
and to a deburred automotive knuckle.

Hitherto, as disclosed in the Unexamined Japanese Patent  
Application Publication No. 2001-80307 and the Examined  
Japanese Patent Application Publication No. Hei7-117548, a  
10 wheel speed sensor of an automobile has been fixedly mounted  
therein in a radial direction with respect to an axle.

When this wheel speed sensor is attached to an automotive  
knuckle, a through hole is drilled toward an inner surface of  
a fitting hole, into which a wheel bearing is fitted, from a  
15 radially outward direction. The wheel speed sensor is fixedly  
attached thereto from this through hole.

However, when the through hole is drilled in the inner  
surface of the fitting hole provided in the knuckle, a burr  
occurs on the inner surface portion of the fitting hole, which  
20 is an open end portion of the through hole. To remove the burr,  
the following manual processing is performed. That is, first,  
a special tool having a cutting part is carefully inserted into  
the through hole from the outside thereof. When the cutting  
part is projected into the fitting hole from the open end portion  
25 of the through hole, the cutting part is outthrust in such a

way as to abut against the open end portion of the through hole.  
Then, the cutting part is rotated to thereby remove the burr.  
Upon completion of deburring, the tool having the cutting part  
is returned to a central portion of the through hole. Finally,  
5 the tool is drawn out of the through hole.

An operation of performing processing by using such a  
special tool is troublesome. Moreover, even an operation of  
setting the tool at an object to be processed requires high  
precision, because the tool is advanced and retreated through  
10 the through hole.

#### SUMMARY OF THE INVENTION

An object of the invention is to provide a deburring method  
of removing a burr formed at an open end portion of a through  
15 hole without performing a troublesome operation of advancing  
and retreating a special tool from the outside of the through  
hole.

To solve the problems, according to a first aspect of the  
invention, there is provided a deburring method, which comprises  
20 the steps of inserting a cutting tool, which has a diameter  
being larger than that of the through hole and also has a cutting  
part that has a hemispherical leading end portion, into an open  
end portion of a through hole of an object, which is to be processed,  
at an angle at which the tool does not touch the remaining part  
25 of the object, and removing a burr formed at the open end portion

of the through hole by rotating the cutting tool while simultaneously making the leading end portion of the cutting tool obliquely abut against the open end portion of the through hole.

5 Further, according to a second aspect of the invention, there is provided a deburring method for removing a burr formed at an open end portion of a through hole that is opened to an inner surface of a fitting hole formed in an automotive knuckle so that a wheel bearing is fitted into the fitting hole. This  
10 deburring method comprises the steps of inserting a cutting tool, which has a diameter being larger than that of the through hole and also has a cutting part that has a hemispherical leading end portion, into an open end portion of a through hole of an object, which is to be processed, at an angle at which the tool  
15 does not touch the remaining part of the knuckle, and removing the burr by rotating the cutting tool while simultaneously making the leading end portion of the cutting tool obliquely abut against the open end portion of the through hole.

According to a third aspect of the invention, there is  
20 provided an automotive knuckle having a fitting hole to which a wheel bearing is fitted. This automotive knuckle comprises a through hole opened in an inner surface of the fitting hole. In this knuckle, an open end portion of the through hole is deburred by inserting a cutting tool, which has a diameter being  
25 larger than that of the through hole and also has a cutting

part that has a hemispherical leading end portion, thereinto  
at an angle at which the tool does not touch the remaining part  
of the knuckle. A burr formed at the open end portion of the  
through hole is removed by rotating the cutting tool while  
5 simultaneously making the leading end portion of the cutting  
tool obliquely abut against the open end portion of the through  
hole. The contour of the open end portion is shaped nearly  
like an ellipsoid having a major axis and a minor axis.

According to the first, the second and the third aspects  
10 of the invention, deburring can be achieved only by using a  
cutting tool having a cutting part, whose leading end portion  
is hemispherical, without using a special tool similarly as  
the related art does. Further, the positioning of the cutting  
tool can easily be achieved only by setting the hemispherical  
15 leading end portion of the cutting tool at an angle at which  
the cutting tool does not touch the remaining unprocessed part  
of the knuckle that is an object to be processed. Thus, automatic  
processing by a machine is enabled.

## 20 BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a plan view illustrating a knuckle according  
to an embodiment of the invention.

FIG. 2 is a sectional view taken on line II-II of FIG.  
1.

25 FIG. 3 is a sectional view taken on line III-III of FIG.

1.

### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Hereinafter, an embodiment of the invention is described  
5 in detail with reference to FIGS. 1 to 3.

FIG. 1 shows an automotive knuckle 1 according to an  
embodiment of the invention. A fitting hole 2, to which a wheel  
bearing (for example, a ball bearing) is fitted, is constituted  
by a cylindrical concave portion, and is provided in the central  
10 portion of the knuckle 1.

Cutting, such as finish boring, is performed on the knuckle  
1 after cast processing thereof.

The fitting hole 2 of the knuckle 1 consists of a cylindrical  
inner surface 4, which is fitted onto the ball bearing that  
15 is a wheel bearing, and of a bottom portion 6. The ball bearing  
is put on a ring-like step portion 5 provided in the vicinity  
of the bottom portion 6.

A through hole 3 is provided in such a way as to be opened  
in an inner surface 4 of the fitting hole 2 and as to be passed  
20 through the knuckle from an outer surface of the knuckle 1.  
Because the through hole 3 is provided perpendicularly to the  
inner surface 4 of the fitting hole 2, boring cannot be performed  
with a drill from the inner surface 4. Therefore, the boring  
is performed from the outer surface of the knuckle 1. Thus,  
25 a burr is produced on the inner surface 4 of the fitting hole

2 by boring.

A cutting tool, which has a diameter being larger than that of the through hole 3 and also has a hemispherical cutting part provided at a leading end thereof, for example, a ball  
5 end mill 9 is made to obliquely go into the fitting hole of the knuckle 1, which is an object to be processed, at an angle of, for instance,  $45^\circ$ . Then, the leading end portion of the ball end mill 9 is made to abut against an open end portion 7 of the through hole 3. Moreover, deburring (or cutting) is  
10 performed by rotating the ball end mill 9. In this embodiment, when an entrance angle, at which the ball end mill 9 goes into the fitting hole, is, for example,  $45^\circ$ , the entire peripheral edge part of the open end portion 7 can reliably be deburred without contact of the ball end mill 9 with the through hole  
15 3 except the open end portion 7 thereof.

The leading end portion of the ball end mill 7 is hemispherically shaped and has a cutting part. The diameter of the ball end mill 7 is larger than that of the through hole 3. Thus, even when the entrance angle is  $45^\circ$ , the deburring  
20 of the peripheral part of the open end portion of the through hole 3 can be performed.

Because the inner surface 4 of the fitting hole 2 of the knuckle 1 is cylindrical, the contour of a deburred open end portion 8 of the through hole 3 has an ellipsoidal shape whose  
25 transverse axis is longer than the longitudinal axis thereof,

as illustrated in FIG. 3, when viewed from the front of the knuckle 1.

Upon completion of deburring by using the ball end mill 9, a wheel speed sensor 10 is fixedly attached to the through hole 3, as shown in FIG. 2.

Incidentally, the invention is not limited to this embodiment. Various modifications may be made without departing from the spirit and scope of the invention.

For example, although the fitting hole 2 of the knuckle 1 of the aforementioned embodiment has the bottom portion 6 and is a concave part, the fitting hole may be passed through the knuckle 1 to the back surface thereof.

Further, the shape of the inner surface of the fitting hole is not limited to the cylindrical one. The inner surface of the fitting hole may have any shape as long as the inner surface thereof is a surface to be processed, which is caved in like a bag similarly to the inner surface 4 of the fitting hole 2 of the knuckle 1. Even when the object to be processed is another kind of an object provided with a through hole having an open end portion, to which deburring cannot be performed perpendicularly, similar advantages are obtained.

Furthermore, although the ball end mill is used as the cutting tool in the aforementioned embodiment, other chamfering tools may be used as long as each of the chamfering tools has a diameter being larger than that of the through hole 3 and



also has a hemispherical cutting part provided at the leading end portion thereof.